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STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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Fig 1

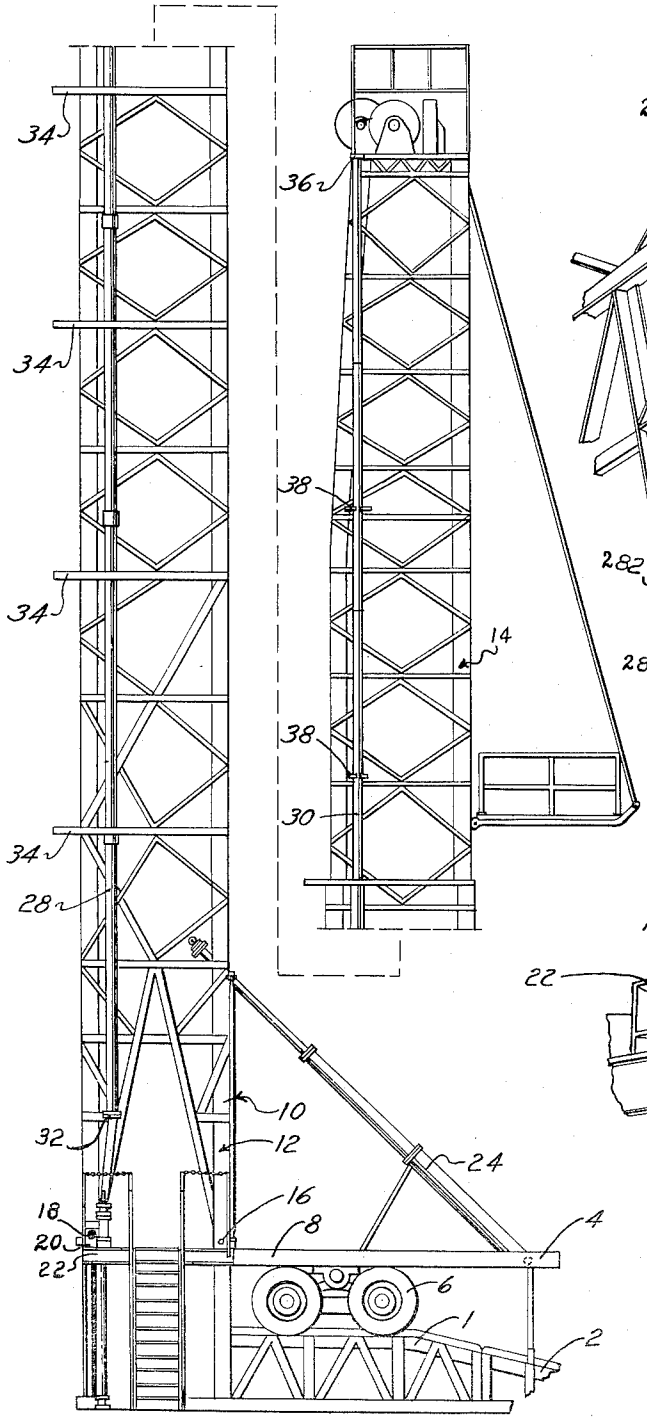
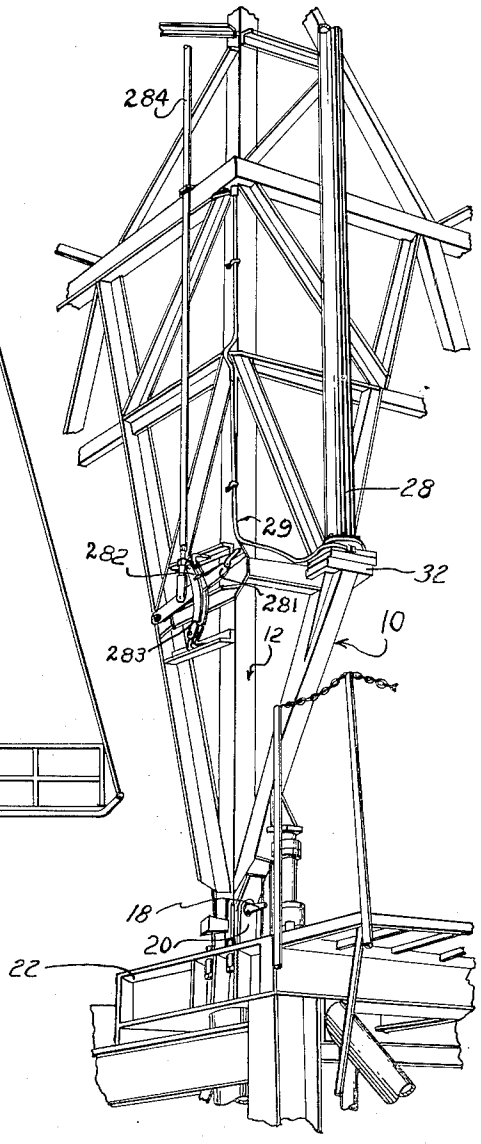


Fig 2



INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT

Jan. 16, 1962 J. H. WILSON 3,016,992

STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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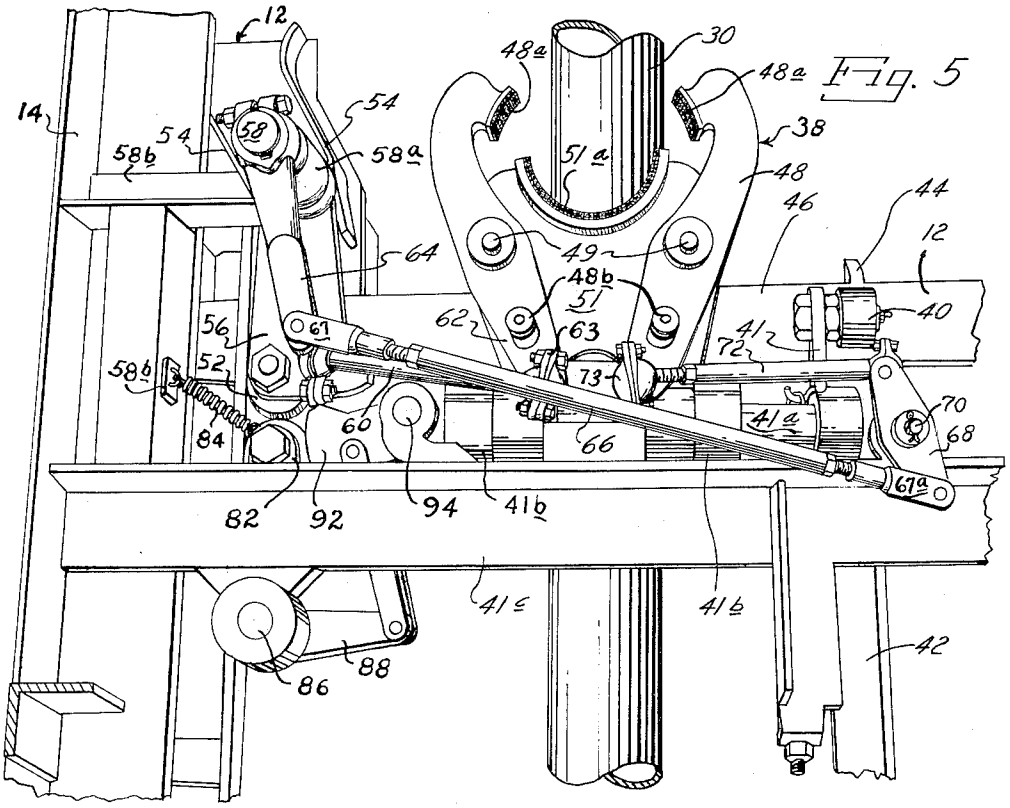


Fig. 5

Fig. 3

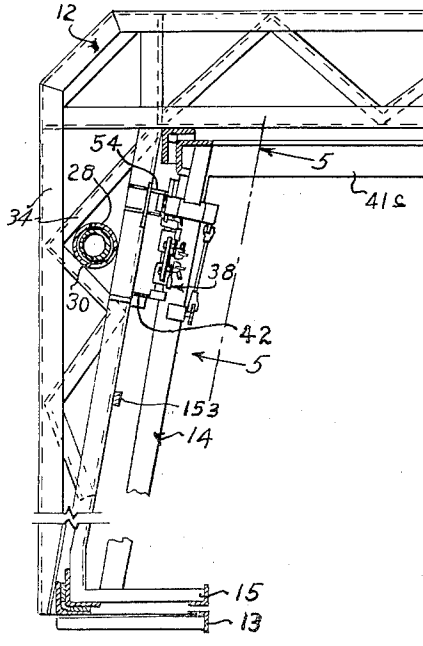
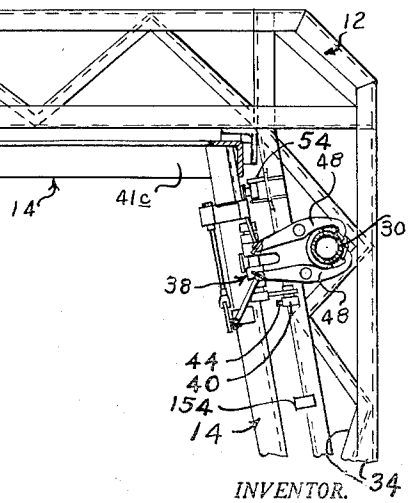


Fig. 4



INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT.

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Fig. 6

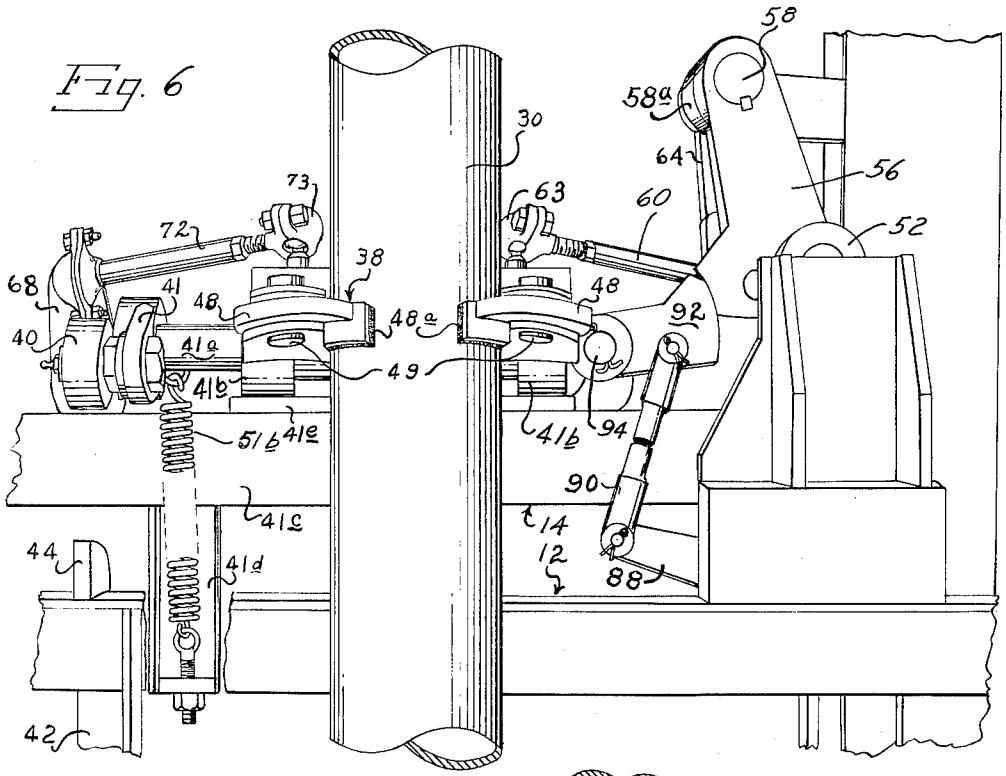
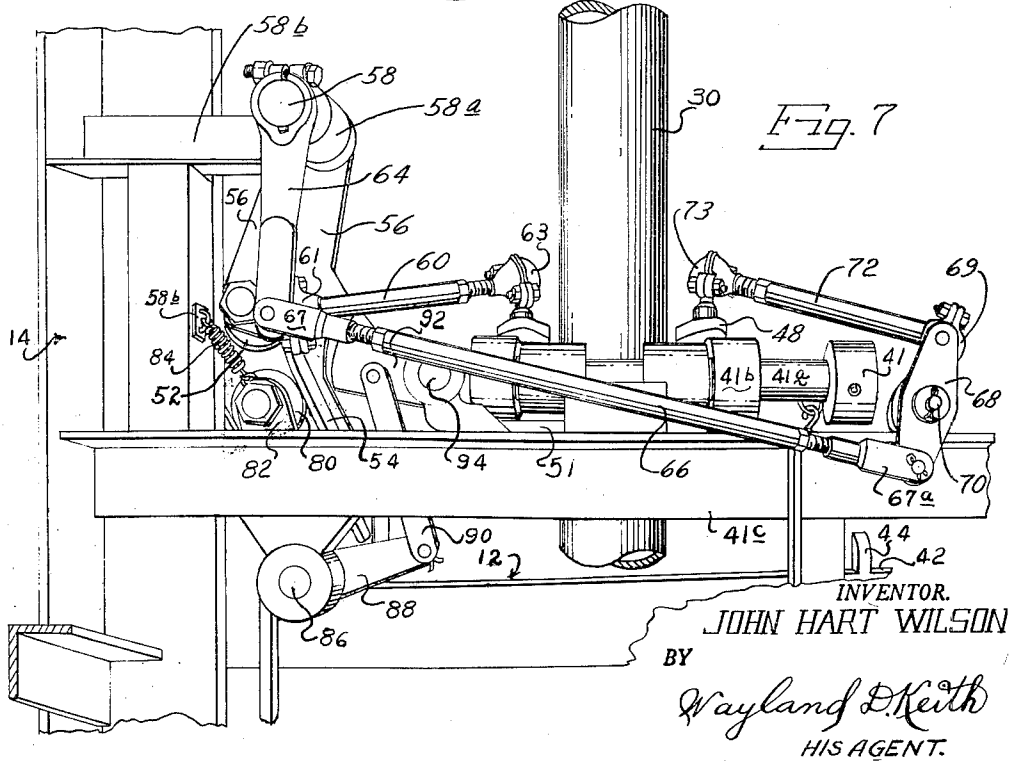


Fig. 7



INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT.

Jan. 16, 1962 J. H. WILSON 3,016,992

STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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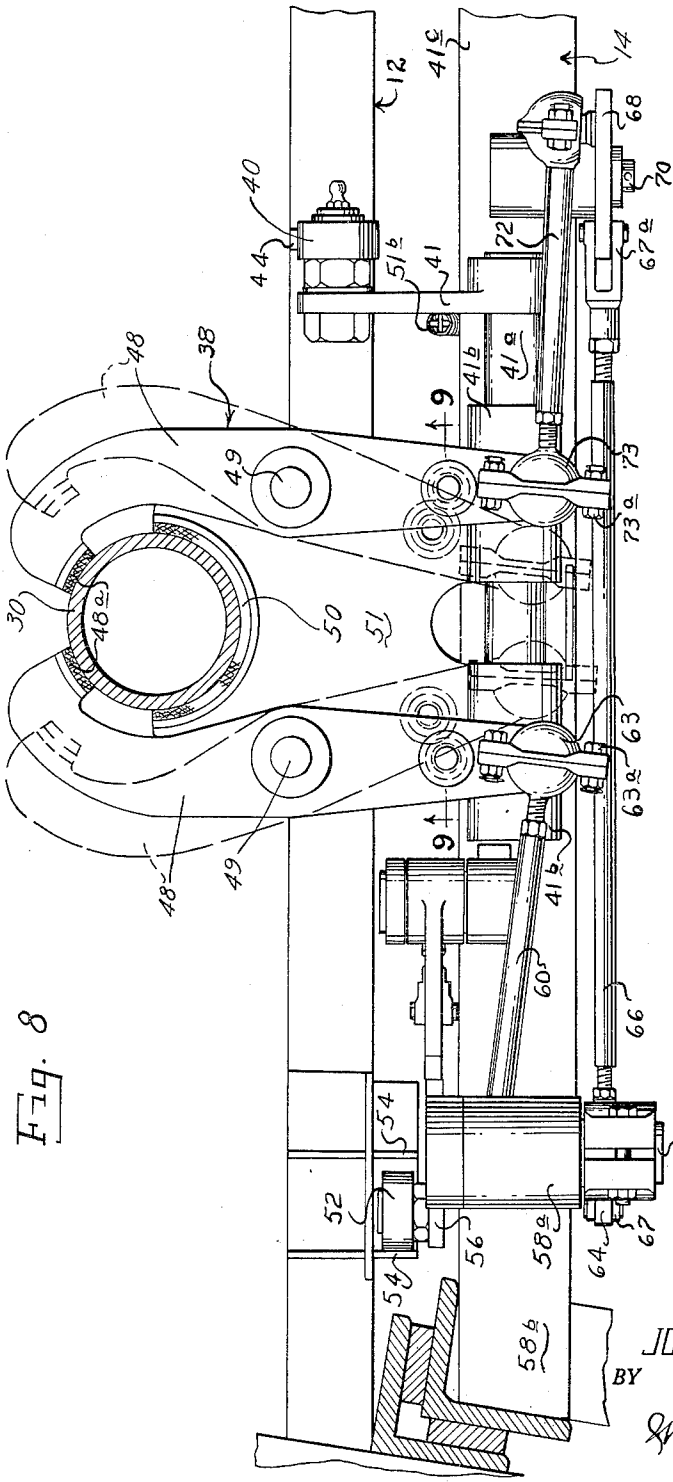

Fig. 8

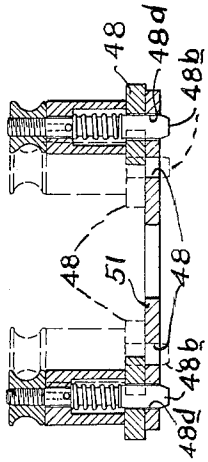

Fig. 9

INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT.

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STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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Fig. 11

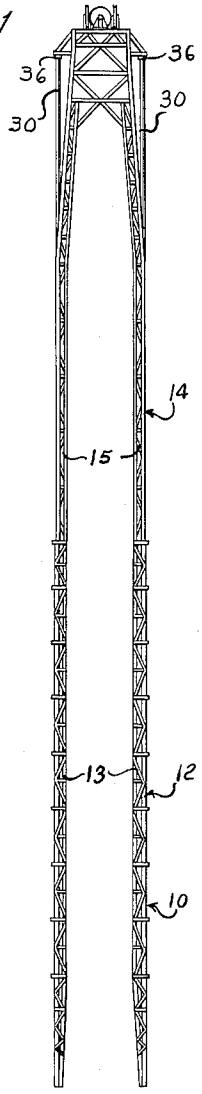


Fig. 10

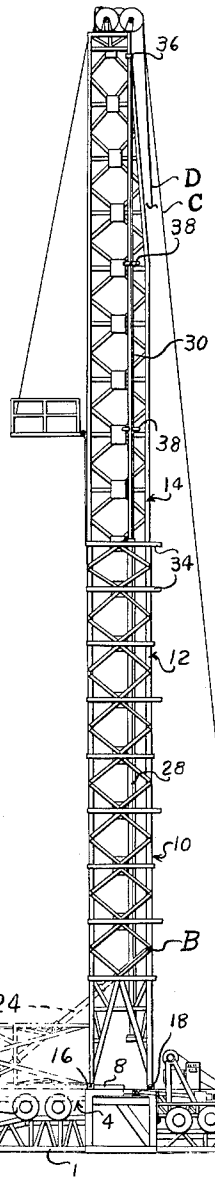
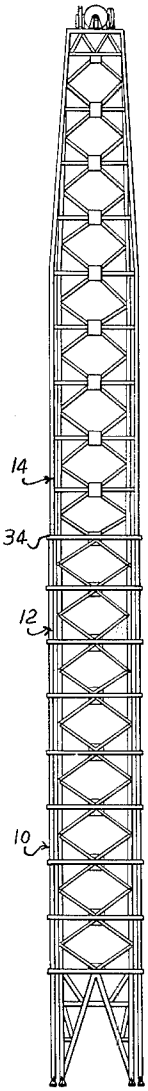
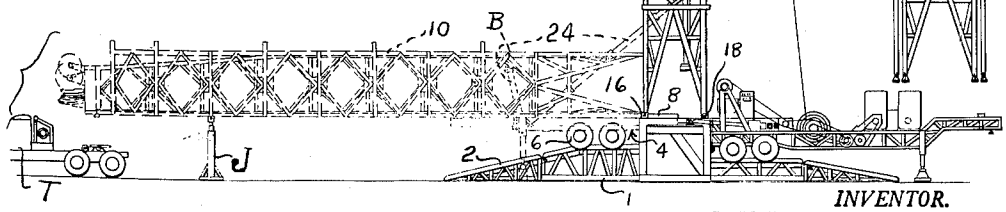


Fig. 12





INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT.

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STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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Fig. 13

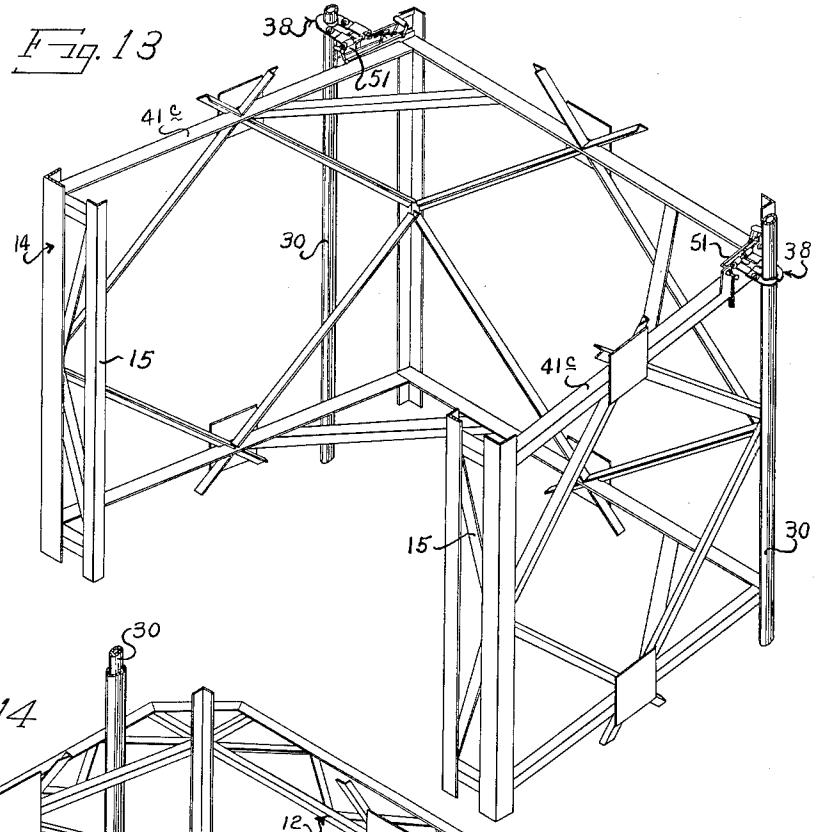
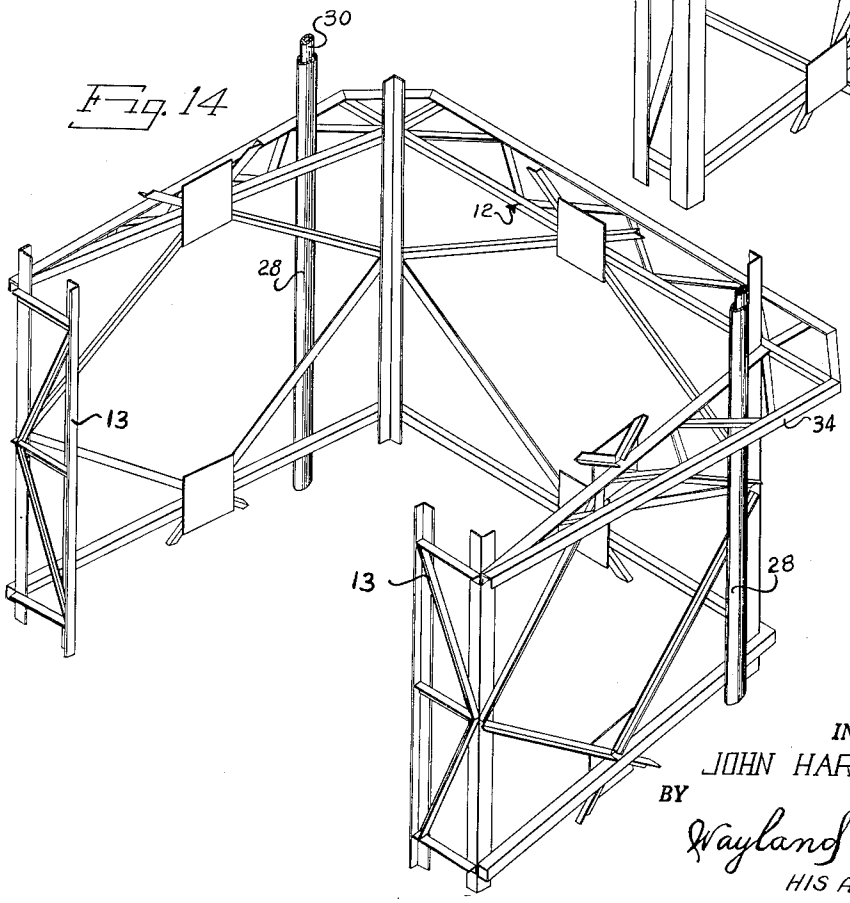


Fig. 14



INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT.

Jan. 16, 1962 J. H. WILSON 3,016,992

STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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Fig. 16

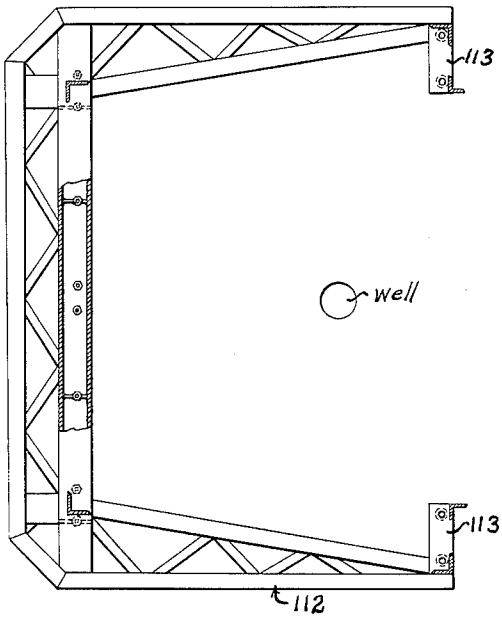
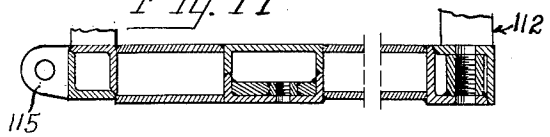


Fig. 15

Fig. 17



INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT.

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STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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Fig. 18

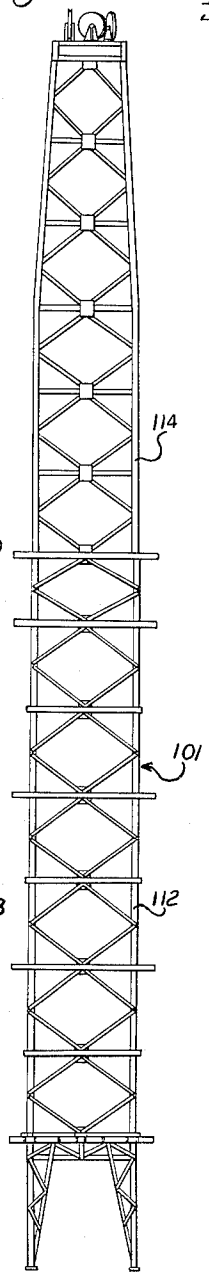


Fig. 19

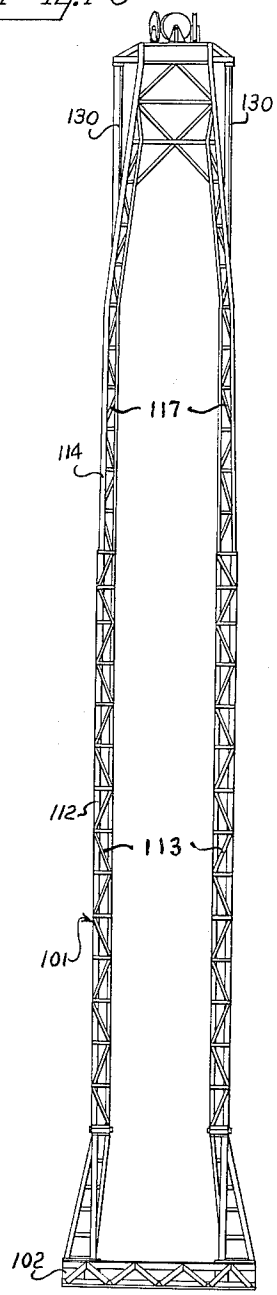


Fig. 21

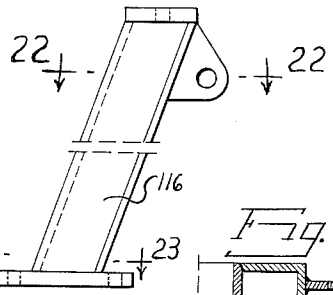


Fig. 22

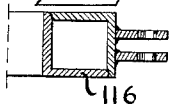


Fig. 23

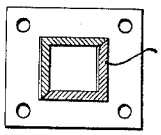
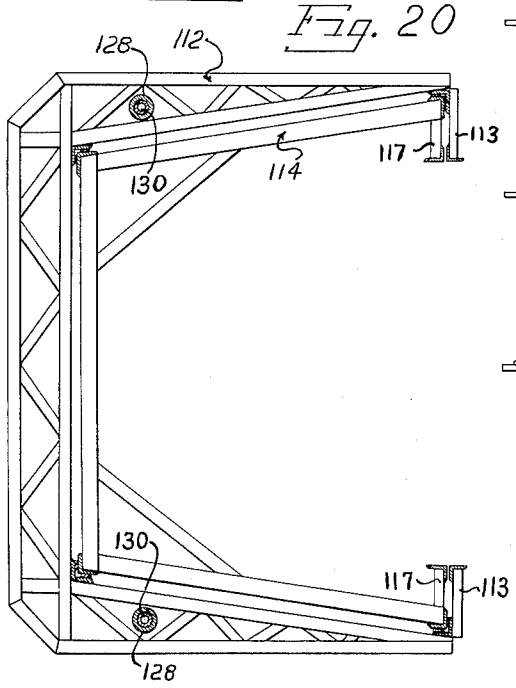


Fig. 20



INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT.

Jan. 16, 1962 J. H. WILSON 3,016,992

STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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Fig. 24

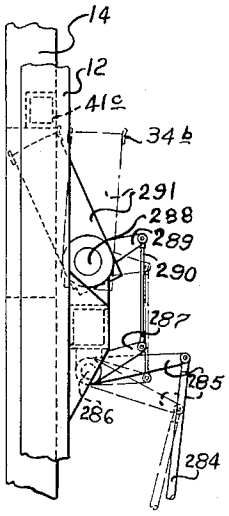


Fig. 25

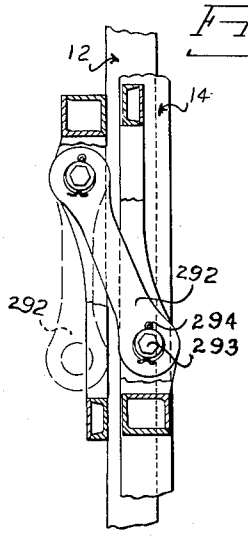
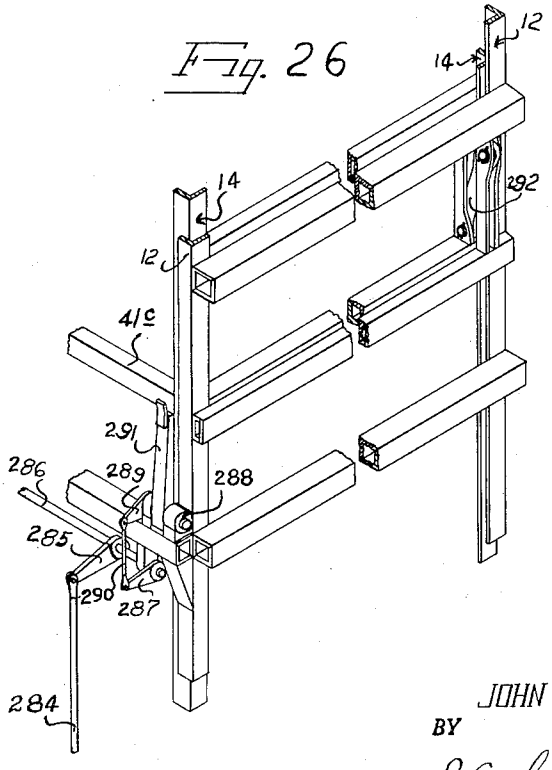


Fig. 26



INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT

Jan. 16, 1962 J. H. WILSON 3,016,992

STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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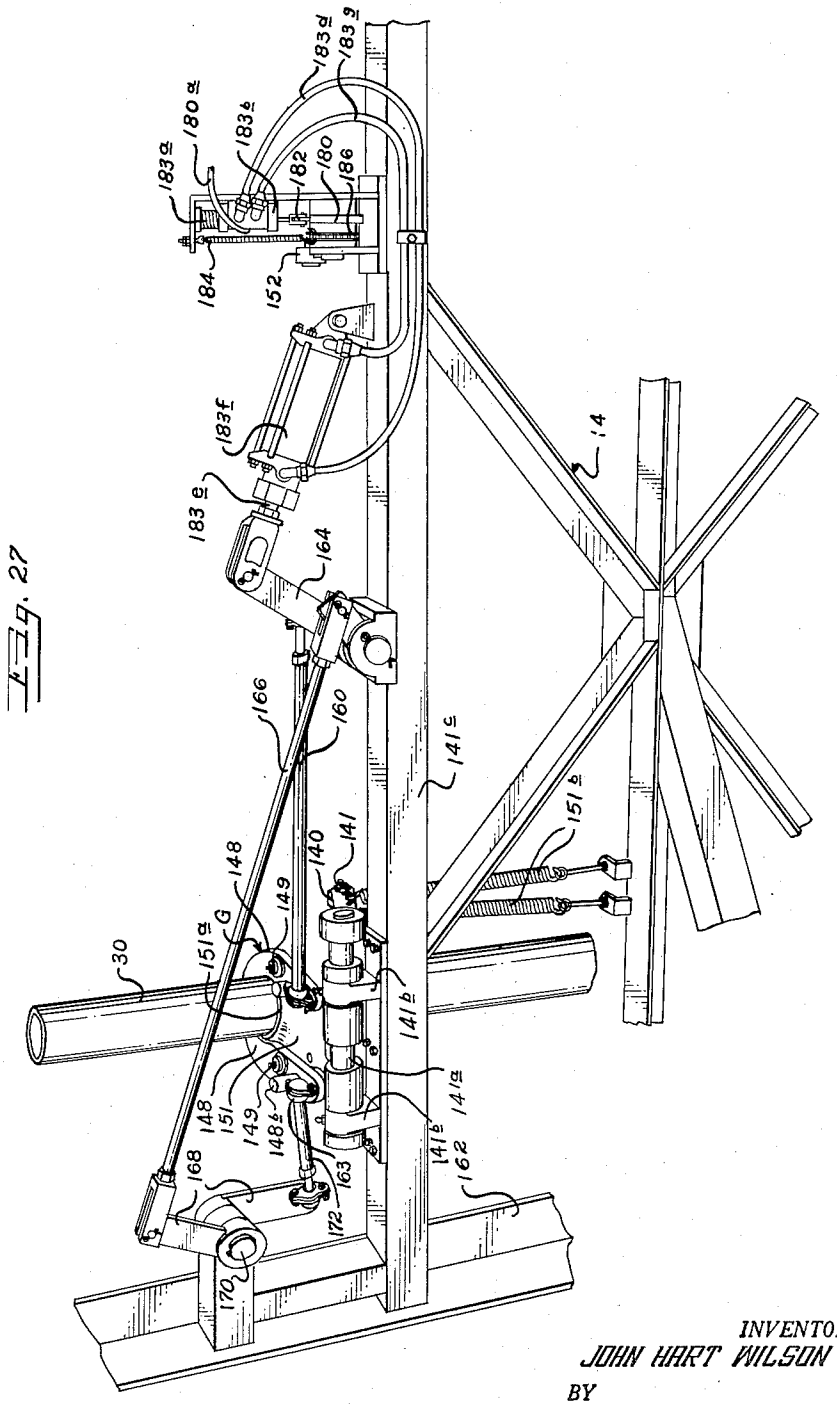
Fig. 27



INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT

Jan. 16, 1962 J. H. WILSON 3,016,992

STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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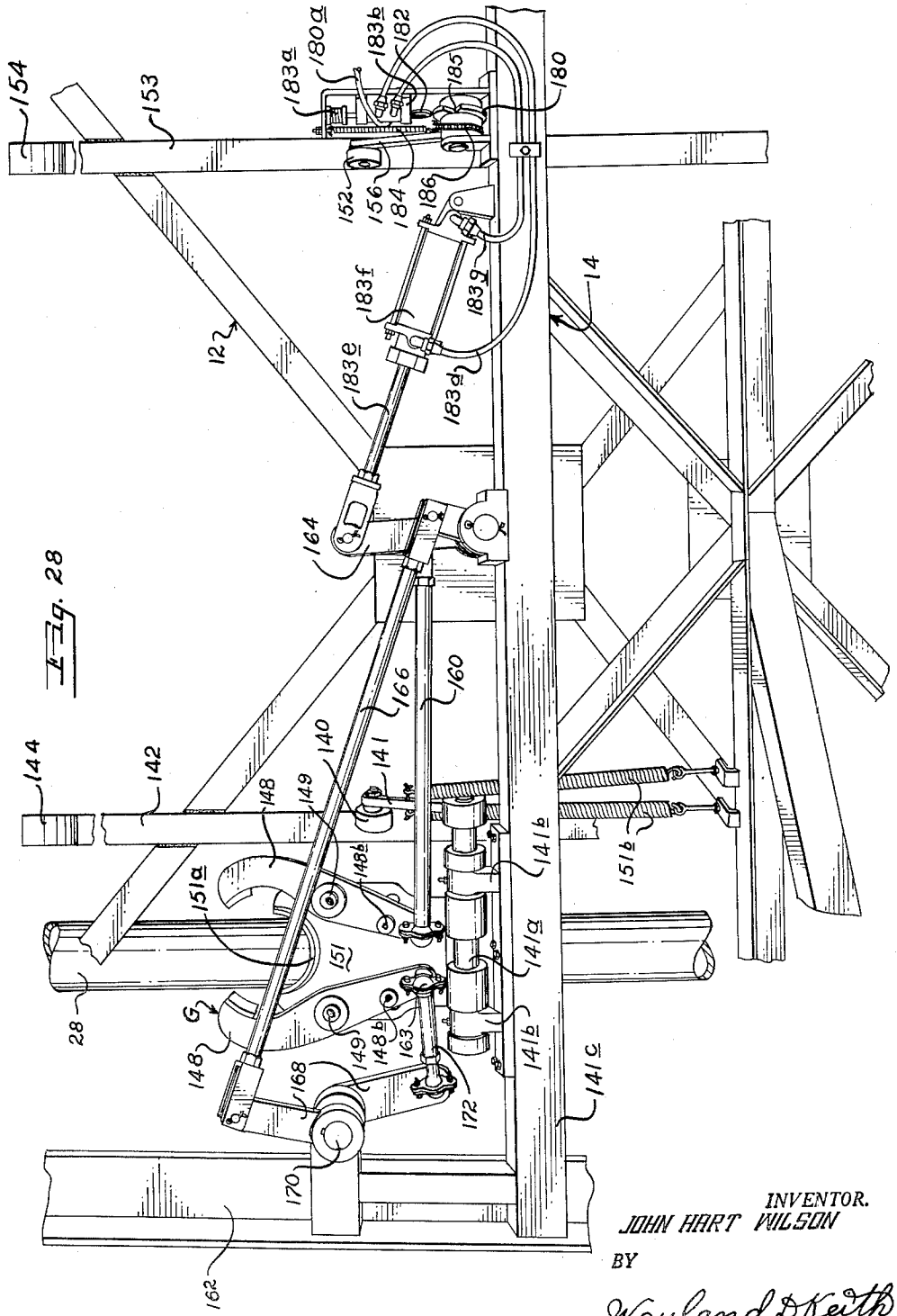

Fig. 28

INVENTOR.
JOHN HART WILSON
BY
Wayland D. Keith
HIS AGENT.

Jan. 16, 1962 J. H. WILSON 3,016,992

STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

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Fig. 29

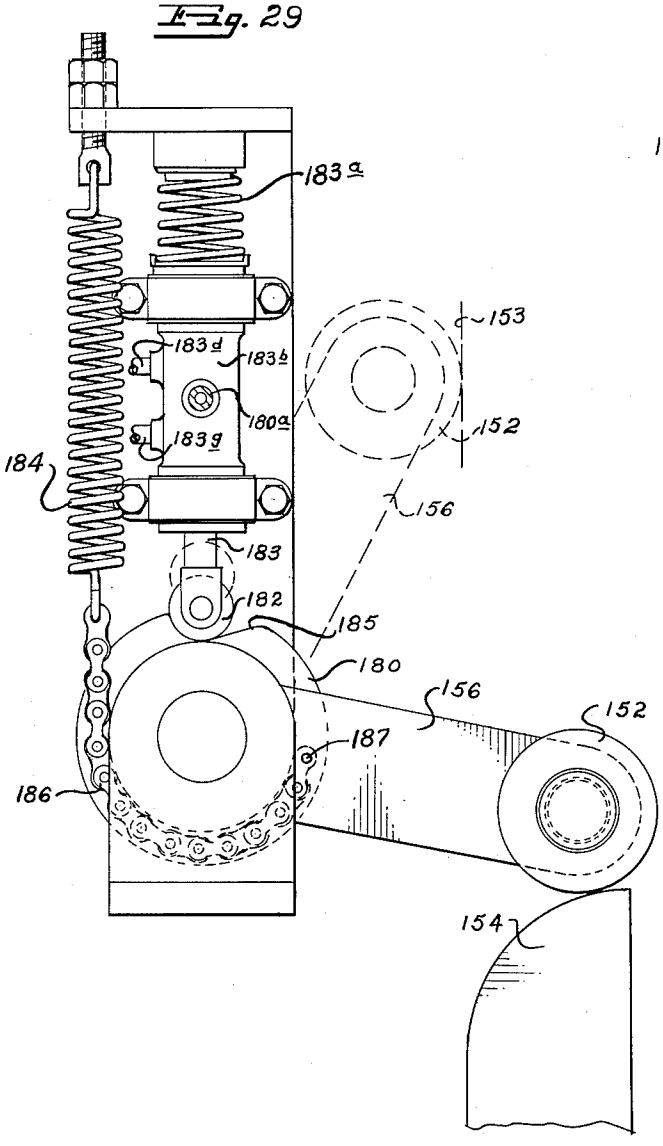
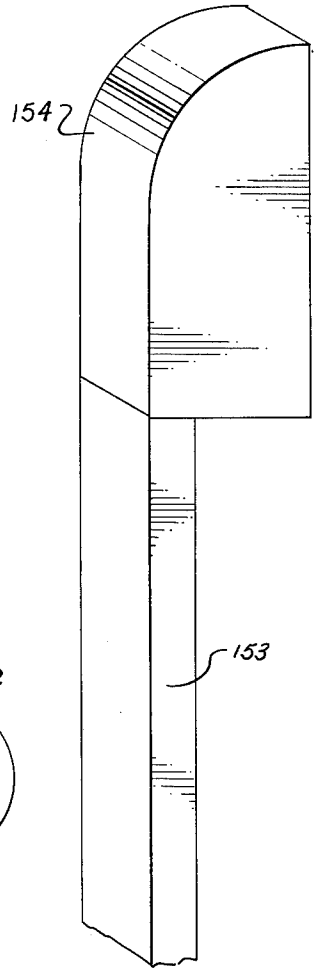


Fig. 30



INVENTOR.
JOHN HART WILSON

BY

Wayland D. Keith

HIS AGENT

United States Patent Office 3,016,992
Patented Jan. 16, 1962

3,016,992
STABILIZER FOR FLUID CYLINDER PLUNGERS OF HIGH SLENDERNESS RATIO

John Hart Wilson, P.O. Box 329, Wichita Falls, Tex.

Filed Oct. 24, 1957, Ser. No. 692,129
15 Claims. (Cl. 189—14)

This invention relates to derricks and more particularly to hydraulically extensible derricks which utilize hydraulic jacks or rams to raise the derrick from a horizontal to a vertical position, and which has a hydraulic plunger provided for extending the inner portion of the derrick upward to the desired height, and whereby the plungers which extend the inner section upward are stabilized against lateral movement, at spaced intervals along the plunger, as it moves upward out of the hydraulic cylinder.

Various extensible derricks have been proposed heretofore, but extending these by means of hydraulic plungers presented a problem, whereby, if the hydraulic plunger was large enough to be self supporting, in vertical position, it was too large and unwieldy for use on relatively light, high derricks or mast structures.

The present device is so constructed that, after the derrick is moved from horizontal to vertical position by the telescoping rams, the inner section of the derrick or mast is moved upward by a hydraulically actuated plunger, which plunger is automatically stabilized with respect to the inner section, at spaced intervals, as the plunger mechanism is ejected from the hydraulic cylinder, which enables the use of a much smaller hydraulic plunger than has been possible heretofore.

An object of this invention is to provide a derrick which may be raised from a horizontal position to a vertical position, and extended vertically upward, the extended section of which may be locked in place from a remote station.

Another object of this invention is to provide a hydraulically raised derrick, the inner portion of which is moved upward in sliding relation with respect to the lower portion, and whereby the upwardly extended derrick section is positively locked in extended position.

Still another object of the present invention is to provide a plunger gripping mechanism which will grip the plunger of a hydraulic cylinder, which plunger is of high slenderness ratio, at spaced intervals along the length thereof, so as to prevent lateral deflection of the extended plunger.

A further object of the invention is to provide a plunger gripping and stabilizing device which will automaticaly engage the plunger, at spaced intervals therealong, as the plunger is extended, and which will automatically disengage the plunger as the plunger is telescoped into the hydraulic cylinder.

Still another object of the invention is to provide a hydraulic plunger gripping mechanism for gripping and stabilizing a plunger, which mechanism is simple in construction, easy to apply, which operates automatically, and which requires a minimum of attention and service.

In the manufacture of portable mast or derrick structures, it is highly desirable to telescope the upper portion of the mast or derrick into the lower portion thereof, so that the structure may be moved from place to place over the highways, and be within the acceptable load length, but which may be raised to an upright position and extended into operating position, to present a mast or derrick of sufficient height to enable the handling of rotary drill stem or pipe in long lengths, so as to expedite the drilling and/or servicing of deep wells, such as oil wells or the like.

The present device is capable of being used with one

or more hydraulic cylinder plungers, depending upon the design and construction of the derrick with which it is used. In the present instance, two hydraulic cylinders, with plungers therein, are shown within the side bracing of the derrick structure, one on each side thereof, with hydraulic grippers being secured to the inner derrick or mast section in such manner that, as the inner portion of the derrick moves upward, by the action of the hydraulic plungers, the grippers will automatically grip the respective hydraulic cylinder plungers at spaced intervals therealong, as the inner portion of the mast or derrick is pushed upward out of the outer portion thereof, thereby stabilizing the plungers against lateral movement, in such manner that the necessary amount of thrust may be transmitted from the hydraulic cylinder to the inner derrick portion, through the plungers, yet the plungers need only be of sufficient cross-sectional area to enable the hydraulic lifting of the derrick or mast, thereby making possible great saving in material and in the weight of the mechanism.

An embodiment of this invention is illustrated in the accompanying drawings in which like reference characters designate like parts in the several views thereof, in which:

FIG. 1 is a side elevational view of a drilling rig derrick or mast, which is of fabricated construction, and shows a hydraulic cylinder and plunger installed therein and connected thereto;

FIG. 2 is an enlarged, fragmentary, detailed view showing the lower portion of a derrick, showing the mounting for a hydraulic cylinder thereon;

FIG. 3 is a fragmentary, cross-sectional view through a portion of a derrick, showing a hydraulic plunger therein and showing the hydraulic plunger gripping mechanism in disengaged position;

FIG. 4 is a view similar to FIG. 3, but showing the hydraulic plunger gripping device in engaged position;

FIG. 5 is an elevational view, with portions shown in section, of the hydraulic plunger gripping mechanism shown in raised position, which view is taken substantially along the line 5—5 of FIG. 3, looking in the direction indicated by the arrows;

FIG. 6 is a view taken from the opposite side of the hydraulic plunger from that shown in FIG. 5, but with the plunger gripping devices in engaged position;

FIG. 7 is a view taken from the same side as FIG. 5, but with the hydraulic plunger gripping device in engaged position;

FIG. 8 is an enlarged top plan view of a portion of a derrick, showing portions thereof in section, with the full outlines indicating the engaged position of the plunger gripping mechanism, and the dashed outline showing the disengaged position of the hydraulic plunger gripping mechanism before it is raised into vertical position;

FIG. 9 is a fragmentary view taken on the line 9—9 of FIG. 8, showing how pins may be passed through holes in the arms to manually lock the arms in position;

FIG. 10 is a side elevational view of a drilling rig, taken from the opposite side to that shown in FIG. 1, the derrick being shown in extended position in full outline, the telescoped position thereof being shown in dashed outline, with the truck being shown in position to receive the derrick for transportation, and with the draw works and substructure for the drilling rig being shown in connection with the derrick;

FIG. 11 is a view taken from the front of the derrick and showing the front and top bracing members only, the pipe racking platform is not shown, so as to more clearly bring out the details of construction of both sections of the derrick;

FIG. 12 is an elevational view of the rear of the derrick in extended condition, showing the bracing of the rear side only thereof;

FIG. 13 is a fragmentary, perspective view of the inner or sliding portion of the derrick, shown apart from the outer portion thereof, and showing the plunger gripping mechanism for gripping and stabilizing the hydraulic plunger or ram, which mechanism is shown mounted on a girt of one of the derrick sections;

FIG. 14 is a perspective view of a fragmentary portion of a derrick, showing a section of the lower portion of the derrick with the inner or slidable portion of the derrick removed therefrom, and showing the manner of placement of the hydraulic cylinders with respect to the braces thereof;

FIG. 15 is an elevational view of a modified form of derrick, with the full outline showing the derrick in raised and extended position, and with the derrick shown in horizontal position in dashed outline, with the plunger gripping mechanism shown attached to the upper portion of the derrick and engaging the plunger of the hydraulic cylinder;

FIG. 16 is a transverse cross-sectional view taken on the line **16**—**16** of FIG. 15, looking in the direction indicated by the arrows, with portions thereof being shown in full outline, with portions broken away and with other portions shown in section to show the details of construction;

FIG. 17 is a fragmentary sectional view taken through the lower portion of the modified form of derrick structure, as shown in FIG. 15, with parts therof being broken away and with parts shortened, to bring out the details of construction;

FIG. 18 is a rear elevational view of the modified form of the derrick apart from the sub-structure, and showing the derrick in extended position;

FIG. 19 is a front elevational view of the derrick shown in FIG. 18, but with the racking platform removed, and the rear bracing being deleted to bring out the details of construction;

FIG. 20 is a cross-sectional view taken substantially on the line **20**—**20** of FIG. 15, but showing the derrick in collapsed condition, so as to show the relative positions of the various parts thereof;

FIG. 21 is an enlarged fragmentary, elevational view of one of the derrick support legs, with parts broken away and shortened;

FIG. 22 is a sectional view taken on the line **22**—**22** of FIG. 21, looking in the direction indicated by the arrows;

FIG. 23 is a sectional view taken on the line **23**—**23** of FIG. 21, looking in the direction indicated by the arrows;

FIG. 24 is a fragmentary elevational view, showing a stationary leg portion and a sliding leg portion of a derrick, and showing a locking mechanism therebetween, which locking mechanism is remotely controlled, and showing the locked position of the leg portions in full outline, and the disengaged position thereof in dashed outline;

FIG. 25 shows a sliding leg portion and a stationary leg portion of a derrick, and shows a manually operated locking mechanism for positively locking the stationary leg portion and the sliding leg portion of the derrick integral, with the two leg portions in locked position being shown in full outline, and the disengaged position thereof being shown in dashed outline;

FIG. 26 is a fragmentary perspective, elevational view showing the inner sliding portion of the derrick and the outer stationary portion of the derrick, and showing the remotely controlled means for locking one side of the sliding portion in raised position and locking the other side of the sliding derrick in raised position;

FIG. 27 is a perspective view of a modified form of the hydraulic plunger gripping mechanism, showing the gripper elements in closed position about a hydraulic plunger;

FIG. 28 is a view similar to FIG. 27, but with the hydraulic plunger grippers in released position;

FIG. 29 is an enlarged view of an air valve and the actuating mechanism therefor to operate the gripper elements; and showing an alternate position in dashed outline; and

FIG. 30 is an enlarged perspective view of the air valve actuating cam shown apart from the derrick.

With more detailed reference to the drawings, the numeral **1** designates a support base having a ramp **2** extending outward therefrom. The support base **1** is for the purpose of supporting a trailer, which trailer is designated generally at **4**. The trailer is preferably of the tandem type, and has wheels **6** upon which the trailer body **8** is mounted.

A derrick, designated generally by the numeral **10**, has a lower and outer section **12** and an upper and inner section **14**. The lower section **12** is pivotally mounted on the body **8** of the trailer **4**, by means of pivot pins **16**. Pins **18** connect the opposite legs of the derrick with the respective lugs **20** on sub-structure frame **22**, so as to maintain the derrick structure **10** in upright position.

A telescoping, hydraulic jack **24** is provided for lifting the derrick **10** from a horizontal position to an upright position, in a manner well understood in the art of hydraulic rams.

In the present instance, the section **14**, of the derrick, is telescoped within the section **12** thereof, and when raised to the upright position, the inner and upper section **14** is moved upward by a plunger **30** within hydraulic cylinder **28**, the hydraulic cylinder **28** is sectional and the sectional plunger **30** is adapted to be telescoped thereinto. The hydraulic cylinder **28** is mounted on a support member **32** on the lower portion on each side of the derrick **10**.

The hydraulic cylinder **28** extends upward from within the super-structure of the lower section **12** of the derrick or mast, but is confined within the bracing **34**, at spaced intervals therealong, as will best be seen in FIGS. 3 and 4, so as to prevent lateral movement of the cylinder **28**. The plunger **30** extends upward and outward from the hydraulic cylinder **28**, and has its uppermost end seating against an outstanding support **36**, which support is mounted on and near the uppermost end of the inner and upper section **14** of the derrick or mast.

The gripper mechanisms, designated generally by the numeral **38**, are mounted along the length of the derrick section **14**, at spaced intervals, adjacent plunger **30**, and are cooperative with mechanisms on the upper end of section **12** of the derrick, so as to cause the gripper mechanisms **38** to grip the plunger **30** at spaced intervals, as the plunger **30** is projected from the hydraulic cylinder **28** above the top of derrick section **12**. A cooperative mechanism is mounted on the top of section **12** adjacent plunger **30**, so as to move the gripper mechanism from a vertical position to a horizontal position, and then to grip the plunger, as the plunger moves upward; and to open the gripper mechanism and move it from a horizontal to a vertical position, when the upper section **14** is being lowered into section **12**. In this manner, the operation is entirely automatic and is free from manual operation.

With more detailed reference to the gripper mechanism per se, attention is directed to FIGS. 3 through 8. FIG. 3 shows the gripper mechanism in vertical position diagrammatically, and as attached to a derrick section for gripping the plunger. FIG. 4 is directed to the actual gripping of the hydraulic cylinder plunger.

The gripper mechanisms, designated generally at **38**, are primarily mounted on the transverse girts of the inner section **14** of the derrick or mast, at vertically spaced intervals. The mechanisms may be used in multiple, one above the other, so as to grip and stabilize the plunger **30** with respect to the inner or movable mast or derrick section **14**, as the plunger **30** is projected from the hydraulic cylinder **28**. The gripper mechanisms **38**, have cooperative cam track elements **42** and **54** on the outer, or relatively non-movable section **12** of the mast or

derrick, to actuate the elements of the gripper mechanisms **38** as the gripping mechanism passes out at the upper end of the relatively non-movable derrick or mast section.

The gripper mechanisms each comprise a support plate **51** which pivotally mounts arms **48**, which arms **48** pivot about pivot pins **49**, when the arms **48** are in horizontal position. The arms **48** and plate **51** are moved from the vertical position to the horizontal position and vice versa, by the action of a cam follower roller **40** rolling on cam **44**. The lever **41** and the plate **51** are fixedly secured to shaft **41***a*, which shaft **41***a* is journaled in bearings **41***b*. The bearings **41***b* are mounted on a plate **41***e* (FIG. 6) which plate is attached to girt **41***c* of the inner derrick or mast section **14**.

With the arms **48** in horizontal position, as shown in FIG. 8, the arms are moved from the position as shown in full outline, to that shown in dash outline, or vice versa, by the action of lever and linkage elements. A linkage **60** interconnects lever **56** and the adjacent arm **48** by means of the ball and socket joints **61** and **63** on the lever and arm respectively. The lever **56** is fixedly secured to shaft **58**, which shaft is journaled within a bearing **58***a*, the bearing **58***a* being mounted on support member **58***b* on the inner section **14** of the derrick.

Linkage **66** interconnects lever **64**, secured to shaft **58**, and lever **68**, which lever **68** is journaled on pivot pin **70**, to enable the rocking of lever **68** about pivot pin **70**, upon arcuate movement of lever **64**. Clevis and pin arrangements **67** and **67***a* connect the respective ends of the linkage **66** with the respective levers **64** and **68**.

The lever **68** has a ball and socket joint **69** thereon, on the opposite ends thereof, so, upon movement of lever **68**, a reverse motion will be transferred to a linkage **72** which connects the other arm **48** by a ball and socket joint **73**, the movement of which lever gives reverse movement to this arm, so upon rocking movement of levers **56** and **64**, the arms **48** will move from the position as shown in full outline in FIG. 8 to that shown in dashed outline therein, or vice versa. Upon relative movement between the stationary derrick section **12** and the inner derrick section **14**, a cam follower roller **52**, on lever **56** will engage cam track member **54**, on the outer derrick section **12**, to cause arcuate movement of lever **56**, whereupon, the lever **56** will rotate shaft **58** and the linkages will actuate the arms **48**, when the arms **48** are in horizontal position, from the position as shown in dashed outline, to that shown in full outline, as the inner derrick section **14** of the mast or derrick is moved upward, and from the position as shown in full outline to that shown in dashed outline, as the derrick section **14** moves downward.

As the derrick section **14** moves upward, the arms **48** and plate **51** move from a vertical position, as shown in FIG. 5, to a horizontal position, as shown in FIG. 8, due to the action of the cam follower roller **40** moving off the upper end of cam **44**, and from the horizontal position, as shown in FIGS. 4 and 8, to the vertical position as shown in FIG. 5, upon the cam follower roller **40** becoming engaged with and moving downward on cam **44** within the inner derrick section **12**. The arms **48** are maintained in a vertical position, as the inner section **14** moves downward, due to the fact that the cam follower roller **40** rolls on track **42**, so long as the gripper mechanism on the inner section **14** is below the top of the outer section **12** of the mast or derrick.

Should the cam and linkage arrangement fail to properly function to open and close the arms **48**, bolts **63***a* and **73***a* (FIG. 8) may be removed from ball joints **63** and **73**, respectively, to enable the linkages **60** and **72** to be disconnected from the respective arms **48**, whereupon, the arms may be moved manually from the position as shown in full outline, to that shown in dashed outline in FIGS. 8 and 9, or vice versa. This will enable the arms **48** to be positioned initially in the manner as shown in dashed outline, during the initial upward movement of the inner section **14**, however, when the arms **48** move into horizontal position, pins **48***b* may be removed from holes **48***c*, as shown in dashed outline in FIG. 9, then the arms may be moved to the position, as shown in full outline in FIG. 9, then the pins **48***b* may be replaced in holes **48***d*, which will hold the arms **48** in positive contact engagement with the plunger **30**, after they have been manually moved to this position.

Operation

In the erection of the form of derrick shown in FIGS. 1 through 15, the trailer **4** is moved forward along ramp **2** until it occupies a position on the sub-structure **1**, as shown in FIGS. 1 and 10. With the trailer in this position, and with the derrick in a position to rest upon the truck T, a jack J is used to lift the derrick from the truck T to a position as shown in dashed outline in FIG. 10. Whereupon, the hydraulic, telescoping ram **24**, which is pivotally and permanently mounted at one end on the trailer, the other end of which ram extends upward and is pivotally connected to derrick section **14**, as indicated at B and best seen in dashed outline in FIG. 10, comes into play. Hydraulic fluid is then applied to the ram **24**, which causes the telescoping ram to move the derrick **10** from a horizontal position, as shown in dashed outline in FIG. 10, to the upright position, as shown in full outline therein. Whereupon, pins **18** are passed through holes in lugs **20** on the sub-structure, and through holes in the lower ends of the legs of section **12**, so as to hold the derrick structure in rigid relation with respect to the sills **22**.

With the derrick sections **12** and **14** moved from the horizontal position to the vertical position, and still being in telescoped condition, the hydraulic ram **24** is disconnected at B from the derrick section **14**, and the hydraulic plungers thereof are retracted into the hydraulic cylinder. The telescoped derrick sections are now in vertical position and the ram disconnected therefrom.

With the telescoped derrick sections in vertical position, hydraulic fluid is applied to the lower end of cylinders **28**, by hose **27** which will cause plungers **30**, which are secured to the upper end of the derrick section **14** by means of brackets **36**, to move upward, thereby moving the inner, slidable derrick member or section **14** upward, as shown in full outline in FIGS. 1 and 10.

As the derrick section **14** moves upward within the section **12**, plunger stabilizer mechanisms **38**, such as shown in FIGS. 3 through 9, will move upward with derrick section **14** until such time as one of the plunger mechanisms reaches the upper end of section **12**, whereupon, a cam follower roller **40**, which is mounted on the outer end of lever **41**, rolls along track **42** until it reaches cam **44**, and as the roller rolls off cam **44**, the lever **41** will be moved from a vertical position, as shown in FIG. 5, to a horizontal position, as shown in FIG. 8, and since the lever **41** is secured to shaft **41***a*, as is the plate **51**, the tension of spring **51***b*, one end of which is connected to lever **41** and the other end of which is connected to a bracket **41***d* on the lower side of girt **41***c*, will tend to cause the shaft **41***a* to turn within bearings **41***b* to move the plate **51** and arms **48** from a vertical position, as shown in FIG. 5, to a horizontal position, as shown in FIG. 8, thereby positioning an arm **48** on each side of the plunger **30**, as the inner section **14** of the derrick continues to move upward, a cam follower roller **52**, which is mounted on lever **56**, near the outer end thereof, moves into the cam channel **54**, which cam channel is located on the upper end of the derrick section **12**, and with the lever **56** being fixedly secured to shaft **58**, which shaft is journaled in bearings **58***a* mounted on the upper side of girt **41***c* of derrick section **14**, the shaft **58**, together with the lever **64** secured to the other end thereof, will move through an arc, from the position as shown in FIG. 5, to that shown in FIGS. 6 through 8. Upon continued upward movement of the derrick section **14**, a further cam follower roller **80**, which is mounted on the outer

end of lever 82 of bell crank 88, will move into cam channel 54, which will move bell crank lever 88 upward together with linkage 90, which linkage 90 is connected to a cam locking lever 92, which lever 92 is pivoted on pivot pin 94. As the bell crank lever 88 moves about pivot 86, the arcuate end of cam lever 92 will move into a complementary arcuate section of lever 56, which will prevent retrogression of the lever 56 and will lock the arms 48 against outward movement. A spring 84 is attached to lever 82 and to support bracket 58*b*, so as to maintain the cam locking lever 92 in an engaged position with the arcuate surface of lever 56, when the cam roller 80 moves out of the upper end of cam channel 54. Since the action of cam 54 on rollers 52 has pulled linkages 60 and 66 to the left, as viewed in FIG. 8, one of the arms 48 has been moved from the position as shown in dashed outline in FIG. 8, to that shown in full outline in FIG. 8, by pivoting the arm connected to the linkage 60 on pivot pin 49. However, as the linkage 66 moves the lever 68 toward lever 64, the opposite end of lever 68, connected to linkage 72, has pulled linkage 72 to the right, as viewed in FIG. 8, which will cause the other of the arms 48 to simultaneously pivot on the other of the pivot pins 49, which will cause arms 48 to move simultaneously from the position as shown in dashed outline, in FIG. 8, whereupon, the arcuate end portions of the respective arms will cause the facing material 48*a* to engage the side of the plunger opposite yoke 50, and with the cam lever 92 in engaged position, as shown in FIGS. 6 and 7, the plunger 30 is stabilized against lateral movement.

It is to be pointed out that the various ball and socket joints 61, 63, 69 and 73 permit the plate 51 and arms 48 to swing from a vertical position to a horizontal position, and vice versa, without interfering with the operation thereof.

As the inner, slidable derrick section 14 moves upward, successive plunger stabilizing and gripping mechanisms will repeat, at spaced intervals, the aforementioned cycle, as the cam rollers 40 move off cam 44 and as the cam rollers 52 and 80 move upward and out through cam channel 54. The plunger stabilizer and gripping mechanisms may be mounted along girts 41*c* at vertically spaced intervals, to maintain the plunger 30 in substantially axially aligned relation with respect to the cylinder 28.

Modified form of derrick on which the plunger stabilizer is used

FIGS. 15 to 23, inclusive show a modified form of derrick upon which the plunger stabilizer is used, as shown in FIGS. 5 through 9, which derrick is designated generally at 101. The derrick 101 has a base or substructure 102 on which the draw works 104 and the multiple power units 106 are mounted. The power units 106 are connected to the draw works 104 through a transmission unit 108, in a manner well understood in the art of rotary drilling rigs.

The derrick 101 comprises a lower hingeable section 112 and an upper, telescoping section 114. The lower section 112 is hingeably mounted at 115 on support legs 116 and 118, with intermediate bracings 120 and 122 connected between the legs 116 and 118. When the derrick section 114 is telescoped into derrick section 112, it may be lowered by a hydraulic cylinder 124, from an upright position to the horizontal position, which cylinder is pivotally connected at 103 to the base 102 and to a pivot point 126 on the derrick section 112. When the derrick section is moved from the position shown in dotted outline in FIG. 15 to an upright position, by means of hydraulic cylinder 124, the derrick may be extended from the initial upright position to the position as shown in FIG. 15, by the hydraulic cylinder 128, which has a plunger 130 therein. However, due to the great length of the extended plunger, which is of relatively small diameter, plunger stabilizers or grippers 38, such as shown in FIGS. 3 through 8, are positioned on the slidable section 114, at spaced intervals therealong, so as the derrick section 114 is extended upward from the derrick section 112, these gripper and stabilizing mechanisms 38 will automatically grip plunger 130, at spaced intervals, so as to prevent lateral movement thereof, thereby enabling a plunger of relatively small diameter to be used, whereas, heretofore, it was impossible to extend an unstabilized plunger upward for a length comparable with the extension of the present plunger.

Hydraulic cylinder 128 is seated above the hinge point 115 of the derrick, and is completely self-contained within the two sections 112 and 114 of the derrick, with hydraulic power being supplied through conventional pumps and conduits, to the lower end of the hydraulic cylinder in a manner well understood in the art of hydraulics.

The form of the invention, as shown in FIGS. 15 through 23, enables the derrick 101 to be raised to a vertical position, or it may be lowered into horizontal position by the use of the hydraulic cylinder 124. A hoist line 132 is connected to swing cables 134, so as to enable the lifting of the derrick onto a transport vehicle, barge, railroad car or the like, and by connecting hoist line 136 to swing lines 138 at the points indicated on base 102, the base, including the power unit, transmission, and the draw works, may be loaded onto the vehicle, barge, or the like for transport. It will be seen that this is a composite unit which is readily adapted to be moved from place to place, and set up in a minimum amount of time.

It is to be pointed out that the form of derrick as particularly shown in FIGS. 18 and 19, is similar in construction to the form of the derrick as shown in FIGS. 10, 11 and 12, in that the sections are C-shaped, with the inner section 114 fitting within the outer section 112, and in that the front of the erected derrick is open for the major portion of the length thereof, which enables long lengths of pipe to be racked outside the derrick and moved in through the open face thereof to be lowered into the well or vice versa.

Locking mechanism for derrick sections

FIGS. 24, 25 and 26 of the accompanying drawings, when taken in connection with FIG. 2, disclose the manner of locking the inner telescoping section 14 of the derrick in extended relation with respect to section 12 thereof.

The inner derrick section 14, when raised upward by plunger 30, to its upper-most position, may be initially locked in place by moving lever 281, which is pivotally mounted on the lower portion of derrick section 12, from the lower-most position to the upper-most position thereof, as shown in FIG. 2, whereupon a pawl 282, on the lever 281, engages segmental, notched rack 283, which is mounted near the lower end of derrick section 12. In so doing, a rod 284, which is pivotally connected to lever 281 is moved upward. The upper end of rod 284, FIG. 24, is pivotally connected to the outer end of lever 285, which lever 285 is fixedly secured to a transverse shaft 286, which shaft is pivotally mounted near the upper end of derrick section 12. The shaft 286, which extends transversely across a side of the derrick, has a lever 287 near each end thereof, which levers are fixedly secured to the shaft and are rotatable therewith.

A second shaft 288 is pivotally mounted near the upper end of derrick section 12, and has a lever 289 fixedly secured thereto, and has a rod 290 pivotally secured to the outer end thereof and to the lever 287. A support block 291 is mounted on shaft 288 and is rotatable therewith, and upon movement of lever 285 from the position, as shown in dashed outline in FIG. 24, to that shown in full outline therein, the block 291 will be moved from the position as shown in dashed outline to that shown in full outline in FIG. 24, whereby the block 291 will

move beneath girt **41***c* until stop **34***b* abouts with the outer surface of girt **41***c*, which will indicate that the block **291** is beneath the girt. This operation is performed from the ground, and does not require a workman to climb the derrick, thereby endangering his life or person to engage the safety support blocks **291**.

After the safety support blocks **291** have been engaged, the derrick section **14** will not move downward, even though the hydraulic pressure is released from hydraulic cylinder **28**. However, after the blocks **291** have been engaged beneath the girts **41***c*, as shown in full outline in FIG. 24, a workman may then climb the derrick to swing a connecting link **292**, which is mounted near the lower end of derrick section **12**, from the position as shown in dashed outline in FIG. 25, to that shown in full outline therein, whereupon, the lower end of the link **292** is connected to pin **293** on derrick section **14**, and a cotter key **294** may be placed therethrough, to insure positive rigid connection between the derrick sections.

It is preferable to have the linkage connected at right angles to the axis of the shafts **286** and **288**, with the support blocks **291** positioned at two corners of the derrick structure, as indicated in FIG. 26, with connecting links **292** connected at the other corners of the derrick structure, to connect the inner derrick section **14** to the outer derrick section **12**, it will be seen that the derrick section **14** will be maintained in extended position, even though the hydraulic pressure is released from the cylinder **28**.

To lower the mast, the links **292** are disconnected from section **14**, after hydraulic pressure is applied to cylinders **28** to relieve the weight from the links **292**, whereupon, after the cotter keys and pins **293** have been removed from the respective links **292**, the links are moved from the position as shown in full outline in FIGS. 25 and 26, to the dashed outline position, as shown in FIG. 25. The workman may then descend from the derrick or mast, and with hydraulic pressure being applied to the upper section **14** by cylinder-plunger assemblies **28—30**, the pawl **282** is released from segment **283**, whereupon, the lever **281** is moved downward, and the pawl engaged in the lower-most notch of the segment **283**, which movement of the lever will cause rod **284** to move levers **287** and **288** downward, so as to move support block **291** from the position as shown in full outline in FIGS. 24 and 26, to that shown in dashed outline in FIG. 24, and with the support blocks **291** in this position, the hydraulic pressure may be released from cylinder **28** and the plunger **30**, which is connected to the inner derrick section **14**, and telescoped into its lower-most position, preparatory to lowering the derrick sections **12** and **14** from the vertical position to the horizontal position.

Modified form of gripper mechanism

The form of gripper mechanism as shown in FIGS. 27 to 30 achieves basically the same result as the aforementioned form of the gripper mechanism, as shown in FIGS. 1 through 8, and 13; however the media for actuating the mechanism as shown in FIGS. 27 through 30 is fluid pressure, preferably air.

The plunger **30**, in this form of the invention, is of the same character as the plunger **30** in the previously described form of the gripper mechanism.

The present form of the device has a cross member **141***c* extending between derrick legs **162** so as to support the plunger gripper mechanism, designated generally at G. The arms **148** are pivoted at **149** to a pivot pin, which pivot pin is connected to a plate **151**. One end of the plate **151** has a concave yoke **151***a*, which yoke complementarily fits the plunger **30** when the plate is in horizontal position. The other end of plate **151** is hingeably connected to a horizontal shaft **141***a* so as to enable the gripper element G to move from the horizontal position, shown in FIG. 27, to the vertical position, as shown in FIG. 28, and vice versa. The shaft **141***a* is pivotally mounted on bearings **141***b*, which shaft is fixed against longitudinal movement by set collars near each end thereof. The shaft **141***a* extends outward and has an arm **141** fixedly secured thereto, the outer end of which arm has a cam follower roller **140** journaled on a pin, with the axis of said roller being parallel to the shaft **141***a*. The roller **140** is urged into contact relation with a track **142** by springs **151***b*.

At the top of the lower derrick section **12**, a cam is positioned, an as in the same relative position as the cam **44**, as shown in FIGS. 5 and 8, so as to permit the arm to swing from the vertical position to the horizontal position, as the roller rolls over the cam **44**. In so doing, the springs **151***b* will move the arm from the position as shown in FIG. 28 to that shown in FIG. 27, whereupon, the concave yoke **151***a* will complementarily engage the adjacent side of the plunger **30**, and, as this function takes place, a cam follower roller **152** will roll along track **153** off a cam **154** at the upper end thereof, which will cause the arm to rotate, under the influence of tension spring **184** connected thereto through chain **186**, through approximately 90 degrees. However, the last 30 degrees of movement of the arm will cause a cam **180** to move until roller **182** moves into a cam notch **185** in cam **180**, under the influence of spring **183***a*. The chain **186** is connected by a pin **187** to the lever **156** on the hub of cam **180**.

Upon movement of roller **182** into notch **185** in cam **180**, the plunger **183** will be moved, under the influence of spring **183***a*, which will cause the shifting of the valve within valve body **183***b*, whereupon, the pressure fluid will be directed through the valve **183***b* into hose **183***d*, which will cause the plunger **183***e* to be drawn into the air actuated cylinder **183***f*. In so doing, a lever **164** will be moved from the position as shown in FIG. 28 to that shown in FIG. 27, whereupon, the rods **166** and **160** will be acted upon, and rod **166** will in turn, move pivoted levers **168** about pivot point **170**, which will cause lever **160** and lever **172** to be drawn in opposite directions, which will cause the pivoting of arms **148** about pivot pin **149** to cause the arms to grip the plunger **30**, as will best be seen in FIG. 27.

The cylinder **183***f* is of the double acting type, and upon the reversal of the derrick movement, that is lowering the upper section into the lower section in the manner shown in FIGS. 1 and 15, the arm **156** moves downward until roller **152** contacts the rounded end of cam **154**, whereupon, the movement of the lever, from the position as shown in full outline to that shown in dashed outline, will cause the plunger **183** to move inward against tension of spring **183***a*, which will cause the valve of plunger **183** to direct fluid outward from hose **183***d* into hose **183***g*, which will cause the plunger **183***e* to move from the position as shown in FIG. 27 to that shown in FIG. 28, whereupon, with the arms **148** opened, the inner derrick section will continue to move downward until roller **140** contacts cam **44**, which will move arm **148** from the horizontal position to the upright position.

The rods **160** and **172** are similar in construction to those shown in FIGS. 6 and 7, and have ball and socket joints **161**, **163**, and **173**. Each of these rods has a male and female screw connection within the length thereof, so upon pivoting from horizontal position to upright position, or vice versa, a quarter turn screwing action of one portion of each rod with respect to the other portion thereof is had, which will permit free movement of the arms about shaft **141***a*, without putting twisting strain on the rods **160** and **172**.

Fluid pressure hose **180***a* leads from valve **183***b* to a suitable source of air pressure, such as an air tank (not shown) in the event air pressure is used to actuate the plunger **183***e*. However, in event hydraulic pressure is used, a pair of hoses, similar to **180***a*, connect with a

suitable hydraulic fluid supply, with one of the hoses being the return conduit for the hydraulic fluid. Valves, such as valve **183***b*, are of standard construction and no specific claim is made for the valve per se.

The gripper elements G are mounted substantially in the same manner as shown in FIGS. 1, 13 and 15, at spaced intervals on the inner portion of the derrick, but which are sufficiently close together to maintain the plunger **30** in rigid, aligned relation with respect to cylinder **28**.

The chief difference between this form of the invention and that shown in FIGS. 1 through 15, is that the first described form of the invention is actuated by cam and lever arrangements, whereas, the form of the invention, as shown in FIGS. 27 through 30, has fluid actuated elements to open and close the gripper arms **148**. Positive locking pins **148***b* may be provided to lock the arms **148** in closed position, in the same manner as the locking arrangement shown in FIGS. 5 and 8.

While only a fragmentary portion of the derrick sections indicated at **12** and **14**, have been shown in FIGS. 27 and 28, it is to be understood that the device is applicable for any form of derrick, such as shown in FIGS. 1, 10 and 15, wherein, the inner section telescopes into the outer section, and wherein the cam roller tracks **142** and **153**, on derrick section **12**, are substantially the same as cam roller track **42** and cam **44**, as shown in FIGS. 5 and 7.

The form of the invention, as shown in FIGS. 1 to 14, inclusive, shows the lower section **12** of the derrick as having a short outstanding truss member **13** along the open front thereof, and the upper and inner section **14** shows a similar truss construction **15**, which telescopes into section **12**, as will best be seen in FIG. 3.

A similar construction is shown in the modified form of the invention, as shown in FIGS. 15 through 22, wherein a truss member **113** is shown longitudinally along the open front of the derrick section **112** and braces this section against lateral deflection. A similar longitudinal truss **117** is shown on the upper open front of the inner and upper section **114**, which longitudinal truss member **117** is immediately adjacent and inward of longitudinal truss member **113**.

Having thus described the invention, what is claimed is:

1. In a stabilizer for the plungers of fluid cylinders, a stationary support, a longitudinally slidable member mounted for sliding relation with respect to said stationary support, a fluid cylinder, a plunger telescoped into said fluid cylinder, one end of said cylinder being secured to said stationary support, the upper end of said plunger being secured to said slidable member, means mounted intermediate the length of said slidable member for selectively engaging said plunger, said means comprising a base mounted on said slidable member, a pair of gripper arms pivotally mounted on said base to engage said plunger when said plunger is in one position, and to disengage said plunger when said plunger is in another position, cam means mounted on said stationary support, cam engaging means mounted on said slidable member and being cooperable with said cam upon relative movement of said slidable member with respect to said stationary support to move said gripper arms from one position to another position.

2. A plunger stabilizing device as defined in claim 1, wherein said cam engaging means cooperates with said cam means to move said gripper arms from a vertical position to a horizontal position, when said slidable member is moved in one direction, and from a horizontal position to a vertical position when said slidable member is moved in the opposite direction.

3. A plunger stabilizing device as defined in claim 2; wherein a further cam means is mounted on said stationary support, a further cam engaging means is mounted on said slidable member, so when said slidable member moves relative to said stationary support in one direction, said further cam engaging means will engage said further cam means, connecting means interconnecting said cam engaging means and said gripper arms to move said gripper arms to engage said plunger in opposed relation, and wherein, upon relative movement between said slidable member and said stationary support in the opposite direction, said further cam engaging means will disengage said further cam means to cause said connecting means to move said gripper arms in the opposite direction to release said gripper arms from said plunger.

4. In a stabilizer for plungers of fluid actuated cylinders, a stationary support member, a longitudinally slidable member mounted along said stationary support member for sliding movement with respect thereto, a fluid cylinder having one end thereof mounted on said stationary support member, a plunger telescoped into said fluid cylinder, the upper end of said plunger being secured to said slidable member, support means, a horizontal pivot member, which horizontal pivot member pivotally connects said support means to said slidable member, a pair of gripper arms, pivot means pivotally mounting each of said gripper arms on said support means so said gripper arms will pivot about axes at a right angle to the axis of said pivot of said support means, a cam mounted on said stationary support member, a cam engaging means mounted on said slidable member, means interconnecting said cam engaging means and said support means to move said support means from a substantially vertical position to a substantially horizontal position when said slidable member is moved upward relative to said stationary member, further cam means mounted on said stationary support member, a further cam engaging means mounted on said slidable member, linkage means interconnecting said further cam engaging means with said gripper arms to move said gripper arms into engagement with said plunger when said slidable member is moved further upward relative to said stationary support member, and whereby said further cam engaging means engages said further cam means to move said gripper arms out of engagement with said plunger when said slidable member is moved downward with respect to said stationary support member, and whereby said first mentioned cam engaging means engages said first mentioned cam means upon further downward movement of said slidable member relative to said stationary member to move said support means mounting said gripper arms from a horizontal position to a vertical position.

5. A plunger stabilizing device as defined in claim 4; wherein a lever is pivotally mounted on said slidable member, certain of said linkage means being connected to said lever at one end thereof and other of said linkage means being connected to the opposite end of said lever and to one of said gripper arms, with another of said linkage means being connected directly between the other of said gripper arms and said further cam engaging means so as to move said gripper arms in opposed relation about their respective axes.

6. A plunger stabilizing device as defined in claim 5; wherein said first cam engaging means disengages said first cam means upon upward movement of said slidable member with respect to said stationary member before said further cam engaging means engages said further cam means to move said gripper arms toward each other.

7. In a plunger gripping and stabilizing mechanism to be used with derrick sections, one of which derrick sections is a support member and the other of said derrick sections being a slidable member mounted along said support section and being longitudinally movable with respect thereto, a first fluid cylinder having an end thereof connected with one of said derrick sections, a plunger within said fluid cylinder, the distal end of which plunger is connected with the other of said derrick sections; said plunger gripping and stabilizing mechanism comprising,

a support base pivotally mounted on said slidable member, a pair of gripper arms, each of which is pivotally mounted on said support base with the axes of said pivots being at right angles to the axis pivotally mounting said support base, cam means mounted on said support member, cam engaging means mounted on said slidable member, which cam engaging means is connected with said support base to move said support base from vertical to horizontal position upon said cam engaging means disengaging said cam means upon relative longitudinal movement of said slidable member with respect to said support member in one direction, said support base being movable from horizontal to vertical position upon engagement of said cam means on said support means with said cam engaging means on said slidable member when said slidable member is moved relative to said support member in the opposite direction, a second fluid cylinder mounted on said support member, a plunger within said second fluid cylinder, a first connecting means interconnecting the plunger of said second fluid cylinder and one of said gripper arms to move said gripper arm in one direction upon movement of said plunger of said second fluid cylinder, a second connecting means connected to said plunger of said second fluid cylinder and to the other of said gripper arms to simultaneously move the other of said gripper arms about said pivotal axis in a direction opposite to the movement of said first gripper arm upon movement of said plunger of said second fluid cylinder, a fluid valve mounted on one of said derrick sections, valve actuating means mounted on the other of said derrick sections in position to engage said fluid valve upon relative movement of said movable sections, a fluid conduit connected to said fluid valve, a pair of fluid conduits connected to said valve and leading therefrom, with one of said conduits being connected to one end of said second fluid cylinder and the other of said conduits being connected to the other end of said second fluid cylinder, so when said slidable member comprising one of said derrick sections is moved with respect to said support member in one direction, said valve actuating means will engage said valve to direct fluid to one end of said second fluid cylinder to move the plunger thereof in one direction, and when said slidable member is moved in the opposite direction relative to said support member, said valve actuating means will engage said valve to direct fluid to the opposite end of said second fluid cylinder to move the plunger thereof in the opposite direction.

8. A stabilizer device for the plungers of fluid cylinders comprising, in combination, a stationary support, a member mounted for vertical sliding movement relative to said support, a fluid cylinder fixed to said support, a plunger telescoped into said fluid cylinder and having its upper end secured to said member, means intermediate the length of said member for engaging said plunger, said means comprising a base mounted on said member, opposed gripper arms pivoted on said base and movable into and out of engagement with said plunger, means on said member for moving said arms into and out of said engagement, and means on said support to actuate said last-mentioned means upon a predetermined movement of said member relative to said support.

9. The device defined in claim 8, said base being pivotally mounted on said member to move from horizontal to vertical position and vice versa, means on said member for moving said base, and means on said support to actuate said last-mentioned means upon a predetermined movement of said member relative to said support.

10. The device defined in claim 9, said means for moving said base including resilient means and a cam follower, said actuating means comprising a cam.

11. The device defined in claim 8, including a plurality of said plunger-engaging means mounted on said member at vertically spaced intervals.

12. The device defined in claim 8, wherein said support comprises the lower section of a telescoping derrick and said member comprises the upper section of said derrick.

13. The device defined in claim 8, said means for moving said arms comprising a fluid pressure operated device and valve means on said member controlling said device, said valve means including a spring-pressed cam follower, and said actuating means on said support comprising a cam positioned to engage said cam follower.

14. The device defined in claim 8, said means for moving said arms comprising a cam follower and a mechanical linkage operatively connecting each said arm to said cam follower, said actuating means on said support comprising a cam positioned to engage said cam follower.

15. The device defined in claim 8, including means on said member for locking said arms in engaged position.

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